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Elaboration of Rubberwood quality: Toward a sustainable sawn wood production

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Introduction

Even if the Southeast Asian countries have overcome most of the technical problems in processing and utilization by over the past 25 years, and the timber successfully marketed internationally, enhanced value of Rubberwood for solid wood products remains typically limited by several factors.

These factors have various origins related to intrinsic wood quality, but also use of unsuited processes, even if appropriated ones exists, and weak knowledge of the markets and the needs of the consumers.

It should be observed that finding the optimum ways to develop and improve utilization of Rubberwood by sawing (or eventually peeling) is also a recurring problem for the main part of the forest species used in plantation for timber production (especially in tropical areas).

Some of these technical aspects are going to be hereafter developed. The main sources of wood variations and factors at the origin of wood quality elaboration will be specifically highlighted. Discussions will be further enlarged to possible application of ecocertification and ecoprocess systems, presently emerging for tropical wood species, to Rubberwood sector.

Elaboration of Wood Quality

Wood manufacturers that are using sawn products from primary processing industry mainly look for stability of their supplying; this stability concerns volumes of wood to feed the factories but also the homogeneousness and appropriate quality of wood in order to satisfy customers needs. Unevenness of supplying can deeply disrupt industrial organization, sometimes endangering the survival of the enterprise. As a matter of fact, marketability of primary processing Rubberwood products closely depends on the level quality and the variability of their quality, taking into account that wood quality can be defined only in appropriateness with the end-products and the constraints their uses involve. A main part of non-quality problems occurring during processing are directly caused by properties and technological behaviour variations, including wood appearance (sawn products grading rules to apply in order to satisfy manufacturers technical demand), and preservation effectiveness.

Inside trees, wood variations and heterogeneousness of technological characteristics are mainly caused by two factors the origins and effects of which are different:

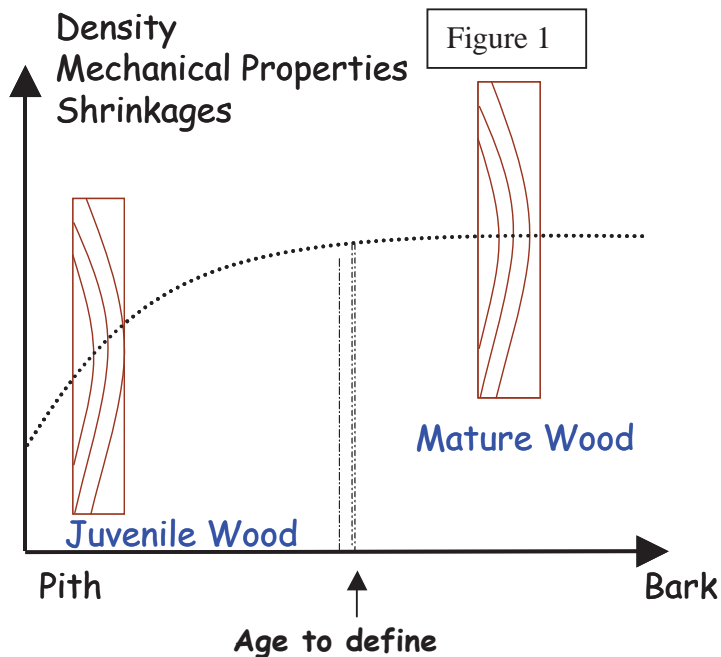
- * Evolution of wood structure from juvenile to mature wood inducing a progressive transition of properties along the radius from pith to bark related to trees age and growth conditions; these variations are particularly observed for mechanical properties and specific gravity, but also natural durability.

- * Development of “flows” of reaction wood (specific tension wood of hardwoods) caused by external factors and inducing circumferential variations of properties; this heterogeneousness can be considered as factual because it occurs occasionally without any real relationship with the development stage of the tree.

Juvenile wood effect: identification of an optimum logging time

Juvenile wood is elaborated during the first years of the tree growth: it is characterized by some properties lower than the ones of mature wood and highly varying along the radius: specific gravity, mechanical properties and transverses shrinkages increase from pith to cambium.

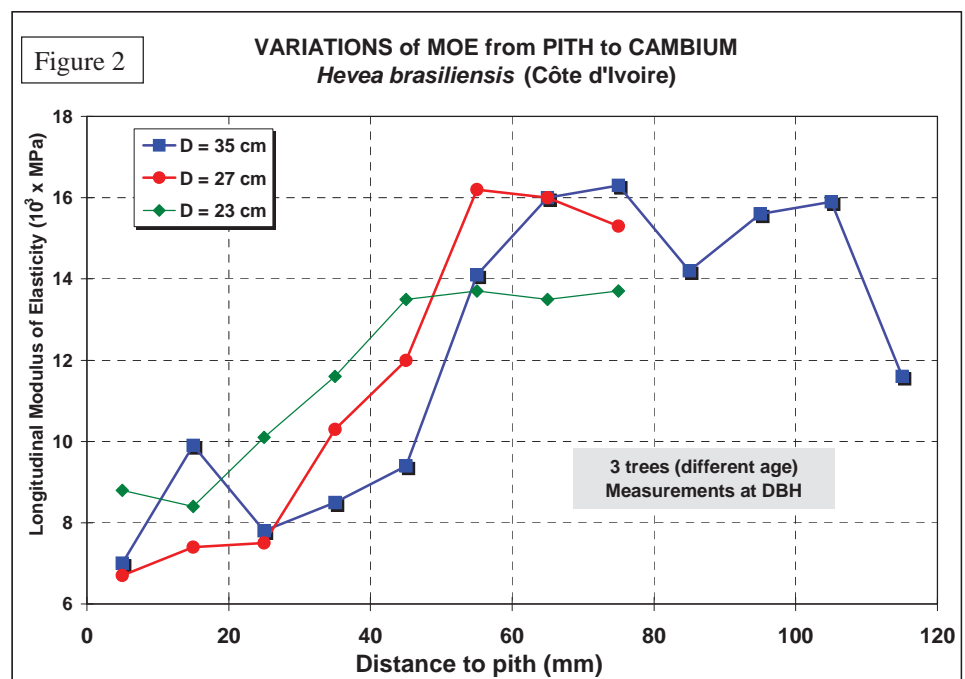
Instead of speaking of juvenile wood, it would be more appropriated to speak about « juvenile decreasing » from pith to bark because radial variations of properties are also observed on very young trees.



For some forest species, age limit between juvenile wood and mature woods would have been defined from studies of anatomical characteristics variations (Zobel and al., 1989); these limits are very theoretical because variations of wood properties particularly depend on growth factors and environmental conditions.

On a technological point of view, main drawback of juvenile wood is linked to the gradient of properties across the section especially for thick boards that have a dissymmetric behaviour and are less stable (figure 1).

For instance, boards entirely taken from juvenile wood have low shrinkages but further tend to warp. These variations have been observed on Rubberwood from Ivory Coast (Africa). According to the results of mechanical tests performed on three stems of different age and diameter, MOE (modulus of elasticity) can vary in a ratio of 1 to 2 from pith to bark (figure 2).



Mature plantations to be clear-cut but which are not logged will later produce higher quality wood due to increasing of [mature wood / juvenile wood] ratio inside the stems. Moreover, wood recently formed at the outermost part of the stem is clear of knots, rising in proportion timber value. However, this tendency has some limits: too much aged and withering stems may present heart decay affecting wood quality and reducing timber value; silvicultural practices and uses of appropriated growth models including quality parameters must help to define the optimum period for logging.

Especially when rubber price drops, Rubberwood plantations owners tend to reduce age of logging, aiming at the nearest incomes. However, this tendency leads to have the maturity of Rubberwood decreasing. Important quality variations may be observed: inside each sawn product characterized by a lack of stability, and between boards inducing wastes and processing problems for the manufacturers.

Effect of tension wood on elaboration of wood quality and processing effectiveness

At the time of felling then crosscutting and sawing, the stresses initially auto balanced during tree growth are suddenly released. Among some species (such as Beech, Poplar, Eucalypts, **Rubberwood**), this releasing, immediately or as a delayed effect, induces the development of splits and distortions with different features according to their location at the end of the logs or in the sawn products.

Otherwise, it involves harmful effects on:

- The quality of the processed products: lower yield, production of out of size sawn wood.
- The equipments maintenance: warping and deterioration of the saw blades, buckling of saw carriages.

Tension wood origin

Inside trees, growth stresses are associated to the formation of wood with particular anatomical structure, the tension wood. During some growth periods, several sectors of wood with properties different of the ones of « normal » wood appear along the stem.

The tangential heterogeneousness of stresses caused by tension wood allows the stem withstanding reorientations induced by changes of environmental conditions (clearing) or competition between trees. Tension wood is caused by a reaction of trees to exterior events (natural such as wind or with anthropogenic origin such as clearing or pruning).

Effect on wood properties

Tension wood is generally characterized by high specific modulus of elasticity and low transverse shrinkages but high longitudinal shrinkage. Thus, it induces fateful effect on wood during drying.

Moreover, similarly to juvenile wood, its influence on wood quality and technological behaviour is mainly linked to properties heterogeneousness inside stem or inside sawn products.

The most frequently, drying problems and end products movements in use are caused by this heterogeneousness.

Effect on sawing quality

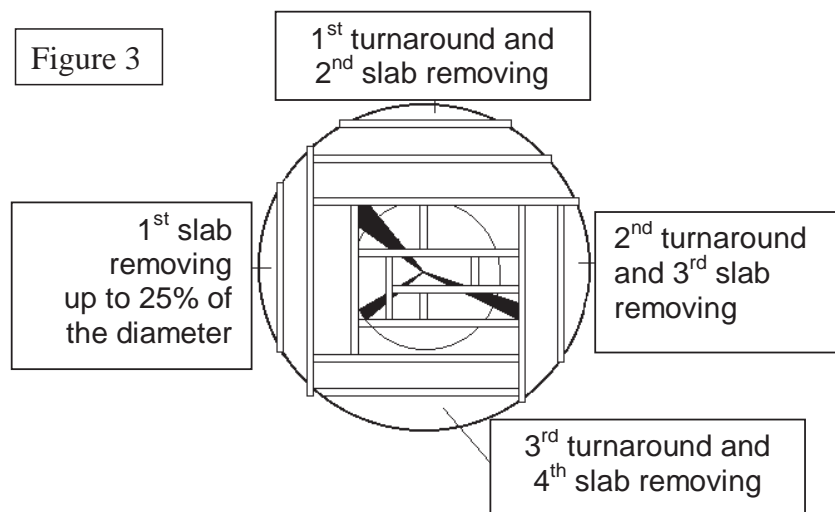
During sawing, modifications of the field of self-balanced stresses cause heart shakes. Sawn products removed near the pith tend to split, but heart shakes mainly appear on the boards including pith that constitutes a low resistance area and a starting point for splits propagation. During parallel sawing, first back-sawn boards frequently curved: the two faces longitudinally shrink inducing a curvature of the cut section towards the bark, called "bow" in the material where the face is curved and "spring" in quarter-sawn boards where the edge is curved. At the same time, the flitch remaining on the carriage will curve in the opposite direction so that the next board will be below the nominal thickness at the ends and above it in the centre.

Appropriated Processing Techniques

Sawing method

Various techniques are utilized in order to overcome splits and distortions caused by tension wood and growth stresses releasing:

- * Symmetrical parallel sawing or "balanced sawing" whereby the flitch is turned through 180° on the carriage after every cut, thus relieving the stresses gradually on both sides of the log.
- * Parallel sawing of half-log: the logs are longitudinally cut along the pith in order to release the main part of the stresses; the two remaining half-logs are further re-sawn according to a parallel sawing pattern.
- * Sawing turning around the log during which stresses are progressively released using a specific sawing pattern: the four slabs are successively removed then the hewed core is back-sawn (figure 3).



Beyond these different techniques, sawing logs with small dimensions leads to considerably limit problems previously mentioned; splits and distortions are all the less frequent since:

- Sawn products have short length (lower radial stresses at the ends of short length planks); Verdhan and Archer (1977) have analytically determined the critical length for logs to be processed: around three times the log diameter.
- Sawn products wideness is limited.

In practice, Rubberwood sawn products are nearly always of small dimensions and consequently do not present sawing defects.

Sawing equipments

Two types of sawing equipments are commonly encountered for Rubberwood: standard fixed band saw or mobile saw. The choice to be done between these two systems depends on several parameters, among other volume of production, nature of the species to process, available budget for the investor.

Standard fixed band saw are frequently equipped with 90cm to 130cm diameter wheel. This type of sawing machine is suited to a large range of species, softwoods or hardwoods, from small to medium diameter. It is very convenient when several wood species with varying diameters are processed in the same unit. Moreover, it can be indifferently used for second cutting operation.

Mobile or semi-mobile saws are especially adapted to small and medium diameters logs, when wood resource is scattered and no installed sawmills exist. They can be moved from one logging site to another with more or less easiness and rapidity according to the type of considered equipment.

Mobile saws present various advantages: low maintenance and technical know-how needs, upkeep can be directly performed on the field, low selling price and consequently low investment capacity need.

Manufacturers propose two main types of mobile saws:

Horizontal band saw: for these equipments, the blade is mobile and the carriage is fixed; it allows a 8 to 12m³ daily sawn wood production in a routine way, depending on sawn products dimensions, species (more or less hard), logs diameters, sawing pattern.

For species as Rubberwood characterised by low to medium hardness, small diameter and short length logs, utilization of band saw with narrow blade (Wood Mizer type) can be considered. This type of equipment is cheap and allows obtaining good quality products. However, it is not adapted to second cutting operations. It allows a 5m³ daily sawn wood production.

Circular saw (single blade or double orthogonal blades): these sawing machines are equipped with at least two orthogonal circular edger blades, sometimes with movable teeth (*Mighty Mite*, *Forestor*, or *Mahoe* type).

During sawing, the two blades are working together, leading to the production of one plank during a one-way operation. It is equipped with a diesel or electric engine. Productivity depends on logs grading according to the dimensions before sawing.

As for mobile horizontal band saws, logs have to be fixed on the ground carriage and the saw frame is mobile. This frame is moving along a beam in parallel to the log. The beam height can be adjusted according to the required dimensions of the sawn products.

To be moved, these semi-mobiles equipments have to be taken apart then transported with trucks. The daily production is between 12 to 17m³ for a 2 workers team.

Drying

Drying is one of the key points of the Rubberwood processing chain. The future quality of the sawn products and further end products depends on this operation. Good and homogeneous drying contributes to limit lack of stability of wood during machining and further operations. It permits to prevent blue stain or decay attacks.

Moreover, it leads to enlarge the possibilities of development of new high added-value products.

Rubberwood sawn products are the most frequently kiln dried in order to speed up drying duration, taking into account low durability of wood.

In front of the large number of drying processes presently existing, the choice and the definition of a kiln drying plant cannot be done without a specific study before investment.

Choice of the process

In a practical point of view, no standard solution exists for this operation because each sawmill has its own production characteristics and it must be also considered the possible evolution of its activity at short- or medium-term.

Kiln drying plant setting up must follow four steps:

1) **Basic data definition:** needs of the present or potential customers according of their uses of the sawn products, range of boards thickness, starting wood moisture content (this parameter is of first importance due to the relationship between useful kiln capacity and drying duration, this duration depending on moisture content), amount of production to be dried, available energy (possible use of wood wastes to feed the boiler), amount of the possible investments.

2) **Technico-economical study of the project:**

* *Technical parameters:* drying duration (information to collect from possible previous tests to be performed) and useful kiln capacity, size of the equipments and heating generator, energy consumption.

* *Economical parameters:* detail of investments (including related equipments), cost price and investments pay back.

3) **Choice criteria analysis:**

* *Technical criteria:* drying duration linked to energy consumption and drying cost price, easiness of the kiln working, maintenance and access to technical assistance.

* *Economical criteria:* amount of investments, financing possibilities.

* *Technico-economical parameters:* possibilities of value-added utilization of wood wastes and by-products.

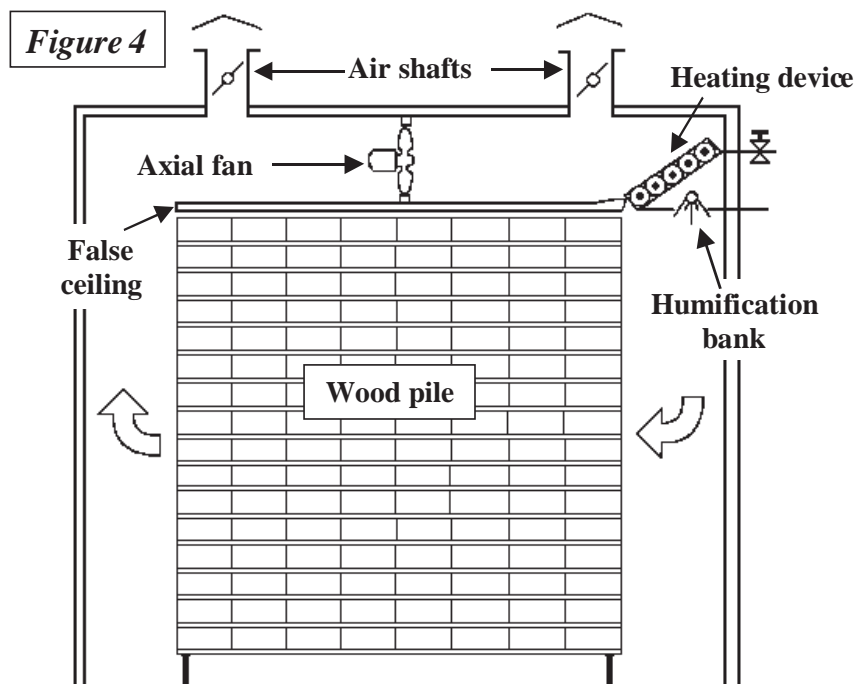
4) **Final decision:** feasibility of the project, choice of the process and definition of the size of the equipments.

Traditional drying

For Rubberwood, the traditional drying technique appears as the most suited. It is a well-tried system that needs simple equipments (figure 4) with a low level of maintenance.

Traditional drying is one of the easiest to run, even if it needs a minimum basic training before building its own field experience.

In order to limit the cost of investments, the kiln structure can be build on the site (works to be directly performed by the company) in co-operation



with the manufacturer who will have to set up the different devices of the kiln: doors, fan system, indoor insulation, monitoring system, air-to-air exchanger, boiler.

Enforcing code of practice

Beyond the choice of the process to be installed and applied, enforcing code of practice is of first importance in order to avoid defects development and insure drying quality.

* Laths thickness and distance between their position depends on the thickness of boards to be dried, as presented on the following table:

Planks thickness (mm)	Laths thickness (mm)	Distance between laths (cm)
18 to 20	20	30 to 40
20 to 40	25	40 to 50
40 to 50	30	50 to 60
50 to 65	35	70 to 80
65 to 85	40	90
>85	45	100

* Appropriate distance between laths prevents pronounced distortions development.

* Laths must be arranged vertically and lined up between themselves, all of them having same thickness; they must be well dried in order to prevent marks on the boards and uneven shrinkage which should rise wood distortions; laths have to be placed at the ends of the piles.

* Piles must be arranged so that air can circulate between boards.

* In order to limit end-splitting especially for large section sawn products, applying end-coating on boards cross-section is advised; this treatment limit humidity exchanges between wood and air, and slow down drying; such treatment is rather cheap and contribute to improve the appearance of the wood piles.

* Weighting piles down during drying (with concrete slab for instance) also allows limiting boards distortions. This technique is simple, cheap, and very efficient, especially for “nervous” wood species as Rubberwood. A weight of 1 ton per m² must be used.

Durability and preservative treatment

Lack of durability (low resistance to attacks of fungi and insects) is one of the main factors reducing range of possible utilizations for Rubberwood.

According to the European standard NF EN 350 that defines the natural durability classes towards wood-decaying fungi, Rubberwood is considered as a non-durable wood (class 5). According to the same standard, it is considered as sensible (class S) to dry wood insects (*Lyctus spp*, *Xylosandrus spp*, *Anobium spp*) because sapwood is not demarcated, and sensible to termites.

On the other hand, its heartwood is easy to treat (class1: sawn wood can be completely and easily impregnated with a treatment under pressure). However, it can be only used when wood is always dry (MC<18%) corresponding to the biological hazard class 1.¹

¹ : A biological hazard class is a situation determined by the in-service condition of the wood. It can change according to the conception or the situation of the work; it does not systematically define the service length, but only the conditions of a potential biological attack. In a biological hazard class, only the specifications for treatment and/or the choice of the species have a direct effect on the service length. Thus, the service length must be interpreted according to the species and the exposure conditions.

Due to these characteristics, Rubberwood can be satisfactorily used only if special cares are taken (drying, treatment) after felling, during all stocking steps when processed up to the end products.

The following table summarizes the main biological risks incurred by Rubberwood related to main families of utilization, and the corresponding treatment process to apply in order to avoid biological attacks.

Class	Main Risks	Examples of Uses	Injection Process		Peripheral Process	
			Sawn Wood Vacuum & Pressure	Machined Wood Double Vacuum	Soaking Spraying	Manual Method
Class I	Insects	Flooring Panelling Interior Joinery Indoor Furniture	+	+	+	+
Class II	Possible Risks of Decay Insects	Carpentry	+	+	+	+
Class III	Important Risks of Decay Insects Possible Risks of Termites	Weatherboarding Exterior Joinery Outdoor Furniture Pallets Packing	+	+		
Class IV	Attacks of Decay Soft Rot Termites	Wood in ground	+			

Certification: a Management Tool For a Sustainable Rubberwood Production

Beyond these technical aspects regarding Rubberwood quality elaboration and non-quality factors, some complementary features have to be highlighted. Because of continuous and heavy pressure organized by environmental NGO, end-users demand for ecocertified products is increasing. Up to now, only criteria regarding sustainable management of forest plantations (or natural forests) have been taken into account. For tropical woods, some actions have been launched to enlarge ecocertification to primary processing activities aiming to increase recoveries, limit wastes through development of ecoprocess.

Such a production of environmentally and humanly friendly timber joined to an efficient chain of custody could be interestingly looked for Rubberwood.

The creation of a certified Clean Processing System (STP) can be a way to contribute to the sustainable development of Rubberwood Southeast Asian industries: allowing a higher production of wooden products by reducing the needs of wood upstream. This kind of system

could also include the origin of products, their quality, the sustainability of the processing systems, as well as the consideration of more respect for environment and local populations. Such a system could cover the whole forestry-wood chain for logs input in sawmills up to end products manufacturing

Ecocertification for forest products and Clean Processing System

Initiatives in voluntary ecocertification of wood-based products have been developing since the beginning of the nineties, in response to an assumed demand by some consumers, to be sure that the timber does indeed come from a sustainable managed forest, taking a serious look at ecological and social factors. Originally targeted on tropical timber, more exposed to criticism, this requirement has gradually extended to all wood-based products. Some countries, like Indonesia and Malaysia, have already adopted measures for ecocertification.

Ecocertification of wood-based products is the expression of an important conceptual innovation, following international reflections on sustainable management, the comprehensive concept that already allied ecology and economy. The certification of a commodity by ecological and social criteria, combining consultation with all of the parties concerned, including NGOs, and a harmonisation at the international level, constitutes a new approach. In fact, no similar initiative exists for other categories of materials such as plastics, steel, aluminium.

Nowadays, the certification of timber has moved from a concept to a reality, with the sporadic appearance of *ecocertified* products in trade. Their market share remains insignificant though, while validity of the labels is very unequal and uncertain.

Certification concerns both:

- 1) Forests / plantations management,
- 2) Forest products through setting up tracking system process (= “traceability”) and chain of custody.

The first one is limited to resources management and doesn’t deal with the following steps linked to end products manufacturing including industrial processing, trades and consumption.

Forest certification has to be considered as a marketing tool aiming to promote sustainable management of forests and plantations. Its main objective is to link forest products marketing and sustainable management of forests, giving to the final customers basic information regarding the management of forests the wood products come from.

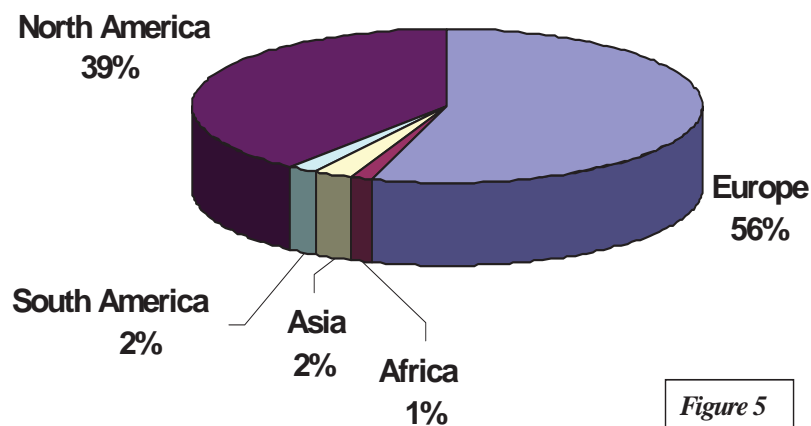
A study would be interesting to be launched in order to measure the feasibility and the acceptability of the Clean Processing System concept related to Rubberwood processing, and would have to be organised in three phases. First, an inquiry with the concerned operators would determinate their sensibility and their ability to react to the creation of this kind of labelling.

Then, by considering positions and interests of the interviewed people, technical requirements - economic, environmental and social – would be proposed for elaborating a certification guideline.

Several application strategies of this labelling would then be defined according to the market potentials, the available consortiums, and the additional partnerships.

Forestry certification in South-East Asia

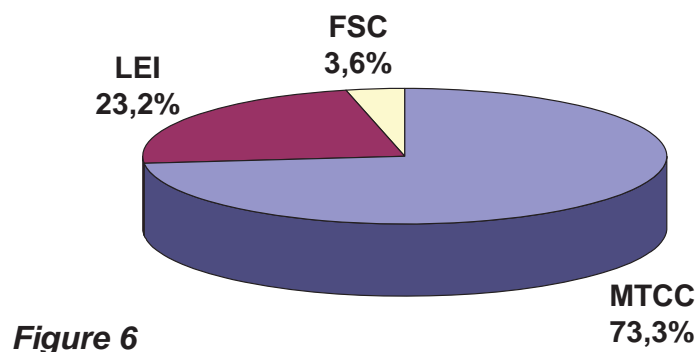
At the beginning of 2002, the total area of certified forests in the world are estimated to 109 millions hectares, mainly in Europe and North America (figure 5).



Developing and emerging countries only represent 8% of the world certified forests, with the wider areas in Malaysia, Indonesia, Brazil and Gabon.

In South-East Asia, certification systems are mainly Malaysian Timber Certification Council² (MTTC) and Lembaga Ekolabel Indonesia (LEI) then Forest Stewardship Council (FSC)³, covering 5.6 millions hectare (figure 6).

Certification systems in South-East Asia



² **The Malaysian Timber Certification Council** is an independent non-profit organization established to plan and operate a voluntary national timber certification scheme to provide assurance to buyers of Malaysian timber products that the products have been sourced from sustainable managed forests. It has a Board of Trustees comprising representatives from academic and research and development institutions, the timber industry, non-governmental organizations and government agencies.

³ FSC is the main Certification System after PEFC (Pan European Forest Certification) for tropical and temperate forest, largely widespread all around the world especially in Latin America (100% of the certified forests of the region), in Africa (36%, but only for plantations) and Europe (29%). In tropical countries, FSC certification mainly concerns plantations.

Rubberwood and ecocertification

Softwood-based products have been more easily certified than those of hardwoods. There are more and larger softwood forest product conglomerates, which market fewer species from forests that are ecologically less complex. For tropical hardwoods, it is difficult to ensure uninterrupted availability with uniform quality and sustained commercial volumes. This is largely due to the fact that supply sources are very fragmented. The ownership problems in tropical developing countries create additional complexity and raise the cost of implementing certification.

Plantation timbers such as Rubberwood have made market inroads, becoming the first certified hardwoods with sufficient volumes for a proper market stance. They are clearly visible in the leading European do-it-yourself outlets and builders' stores, which showcase certified glue-laminated boards, decking, flooring and other interior products. Rubberwood is more typically sold in higher value-added products such as household furniture, kitchen utensils and decorative products.

This species is currently filling some of the market niches previously occupied by Pine and tropical hardwoods such as Meranti. This change of supply is a direct result of the availability of "green" Rubberwood from the plantations of Malaysia and the Far East and the difficulty in certifying the traditional sources of Pine and tropical hardwood.

Most of the Southeast Asian countries, including Thailand, are proceeding to produce a national sustainability standard. However, the market place is demanding FSC certification. In Thailand, both the Forest Industry Organization and the Rubberwood Furniture Industry Association are proceeding with FSC certification as requested by their European customers.

Rubberwood certification idea shyly begins to appear in the production regions. Environmental and ecological awareness is not really to the fore of the industry concerns. However, due to the necessity to strengthen European markets and satisfy the customers requirements, some companies have begun to launch certification approach for Rubberwood production. In Malaysia, Golden Hope company is set as an example of success story for such an initiative.

Golden Hope Rubber plantations certification: a success story

Golden Hope Plantations Berhad (Golden Hope) is a Malaysian company that owns a total area of 18127 hectares planted with two major agricultural crops, Rubber tree (about 12434 hectares), and Oil palm (4966 hectares). Rattan (forest canes) planted under rubber trees (a form of agro-forestry practice) and areas planted with forest species tree nurseries, roads/building/residential areas, conservation lands, effluent ponds, natural water bodies, made up the remaining hectares. Forest tree species planted include Teak, Khaya, Sentang, Bamboo, and Acacia hybrids.

Certification approach

Scientific Certification Systems (SCS), a certification body accredited by the Forest Stewardship Council (FSC), was retained by Golden Hope to conduct a certification evaluation of its Rubberwood plantation areas. Under the FSC/SCS certification system, forest management operations meeting international standards of forest stewardship can be certified as "well managed", thereby enabling use of the FSC endorsement and logo in the marketplace. A preliminary assessment of the Golden Hope plantations was conducted in 2001.

Further to the conclusions of this study, the decision was made by Golden Hope to undergo a full evaluation and the initiation steps (standard generalization, stakeholder notification, and consultation) began at the end of 2001. An interdisciplinary team of natural resource specialists empanelled by SCS conducted the evaluation; gaps within one of the major FSC Principle precluded immediate award of certification.

In the following months, Golden Hope management personnel took focused actions designed to fulfil the gaps. At the middle of next year, a new evaluation team finally recommended to award FSC-endorsed certification to Golden Hope for its management of rubber plantations in Malaysia.

Golden Hope Commitments

Golden Hope is committed to the protection of the environment and sustainable development. The company subscribes to the principles of Total Quality & Environmental Management System (TQEMS) as the way forward towards achieving excellence in the management of quality, safety, health and environment.

Golden Hope's commitment to the protection of the environment and sustainable development is reflected in the Group-wide Total Quality management, Environmental and Occupational Safety & Health Policies. This commitment to the environment is further exemplified in the Company's decision to subscribe to the FSC Principles and Criteria in the management of its rubber estates for the production of Rubberwood timber.

Rubber and Rubberwood related industries form an integral part of Golden Hope's long-term vision as detailed in the Company's **White Book (Long Term Master Plan 2001-2020)**. For this objective, the eleven rubber estates totalling 12434 hectares shall be maintained to ensure continuous supply of raw wood materials to the three wood-based factories, Golden Hope Fibreboard, Golden Hope Parquet and Golden Hope Furniture. The rubber surface will be increased to about 13700 hectares by 2010 through progressive conversion of oil palm fields in these eleven estates.

Moreover, other main commitments (among a much longer list !) of Golden Hope Rubber Plantations are the following:

- To produce Rubberwood timber complying with the Principles and Criteria of FSC,
- To ensure uninterrupted supply of certified Rubberwood timber to Golden Hope wood-based factories and hence to develop a sustainable vertically integrated timber based industries,
- To manage the rubber plantations also for timber production and to ensure that all other uses, functions, and services whether economic, ecological, or social are continuously improved and safeguarded,
- To continuously improve processing of timber resources and enhancing the value of downstream activities,
- To ensure high quantity and quality latex so as ensure profits and sustainability of the business,
- To continuously improve practices relating to the production of Rubberwood timber,
- To ensure that land usage conforms to long-term commitment to environment, workers' welfare and stakeholders' interests.
- To maintain natural spots or areas considered as high conservation value forest as represented by forest patches, water catchments area and area planted with forest species,
- To adopt stringent reduced impact logging (RIL) measures to ameliorate harvesting effects on soil.

Environmental and socio-economic context

Each of the eleven estates undergoing FSC evaluation has an adapted and work force. All housing provided in the estates are for estate employees. Job opportunities are also extended to all eligible dependents of the employees residing in the estates.

The residents are mainly employed on the estates as rubber tappers, oil palm harvesters and other upkeep and general workers. Some dependents work in the nearby towns and factories. Wages paid by the estates are in conformance to the laws of the country and are computed based on collective agreements with either AMESU (All Malayan Estate Staff Union) or NUPW (National Union Plantation Workers).

Educational, medical and recreational facilities are available in most estates. School buses and medical treatments are provided free to the employees and their children. Since there is a shortage for workers, opportunity is given by the management to residents in increasing their monthly incomes by doing piece rated jobs in the afternoon after their normal days work.

The incorporation of downstream activities in the form of Golden Hope Fibreboard, Golden Hope Parquet and Golden Hope Furniture greatly enhances the socio-economic activities of the district in term of employment as well as purchases from the local merchants. Within the harvested area, some local people are employed and they are given skill training.

Chain-of-Custody

At the request of Golden Hope, SCS conducted a joint forest management and chain-of-custody certification evaluation of the defined plantation areas. With respect to Golden Hope, the chain-of-custody focus is on the “stump to mill gate”: chain-of-custody begins with selecting trees on the stump, loading of Rubberwood logs into the trucks and ends with the logs arriving at the Golden Hope factories gates.

During field evaluation, the team also investigated the manner by which Golden Hope can maintain its chain-of-custody over the Rubberwood logs within the forest and those that leave the “forest gate” to assure that only logs from the “defined forest plantation area” would carry the certified status, were forest management certification to be awarded. The evaluation team found that Golden Hope Plantations is subjected to the “Harvesting and Wood Dispatch Procedure” as stated in the Estate Operation Plan.

Certification recommendation

Based upon the full and proper execution of the SCS Forest Conservation Program evaluation protocol, it is the judgement of the SCS Evaluation Team that the management of the Golden Hope Plantations is in compliance with the FSC International Principles and Criteria.

The evaluation team recommends that the Golden Hope plantations be certified, with conditions, as “well managed” under the auspices of the FSC, as determined by the full and proper execution of the SCS Forest Conservation Program evaluation protocols.

Certification of the Golden Hope rubber plantations is recommended because the weighted average scores for the three program elements and the ten FSC Principles each exceed the required threshold. Because four of the fifteen criteria for which scores were awarded received scores below the required threshold, the team recommends award of certification *with conditions*.

Conclusions

Rubberwood has become a main substitute for light tropical hardwoods and as one of the major timbers for the production of furniture and indoor components. The main reasons are its favourable timber and woodworking properties and the relatively low raw material costs

since Rubberwood is an agricultural by-product. Wood quality elaboration mechanisms are known but depend on parameters that have to be defined for this timber species.

An additional asset is its “green” aspect: rubber trees have to be removed for replanting operation once the latex yield has declined to uneconomical levels. A large number of Rubber plantations are now managed in a sustainable manner. The acceptance of Rubberwood as a sustainable, plantation-grown, “environmentally friendly” timber has contributed to its wide appeal.

In order to meet the demand of guaranty from customers from North countries concerning this “environmentally friendly” characteristic, certification system begin to be set up and developed in some South-East Asian Rubber plantations. This operation requires important means and time before being effective and bringing benefits for the concerned company.

However, Rubberwood is a timber species especially suited to apply such a system that will induce profitable fallout at each step of the wood chain.

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